Electronic Version

Stylesheet Version v1.1.1

Description

[Earthquake Protector]

Cross Reference to Related Applications

[0001] Shustov, V., 2000, "Seismic Base Isolation Systems: Promise, Design and Performance", CSUN, http://www.ecs.csun.edu/~shustov/Topic4.htm. Newmark, N.M. and Rosenblueth, E., 1971, "Fundamentals of Earthquake Engineering," p. 529, Prentice-Hall, Inc., Englewood Cliffs, N.J. Sassaki, T. et al., 1993, "Vibration-Proofing Device", U.S. Patent 5,261,200. Shustov, V., 2001, "Earthquake Protective Building Buffers," online test demonstration, CSUN, http://www.ecs.csun.edu/~shustov/001-EPF-03.html.

Background of Invention

[0002] 1. Field of the Invention

[0003] The present invention relates to earthquake protection of building structures. More particularly, the invention relates to seismic isolation techniques.

[0004] 2. Description of the Prior Art

[0005] The concept of suppression of seismic energy or diverting its flow from entering a building structure is known as a seismic or base isolation. Normally, this technique needs some sort of pads to be inserted under all major load-carrying elements in a basement of the building. It also requires creating additional rigidity diaphragms in the basement of the building and a moat around the building, as well as making additional provisions against overturning and/or P-D effect. Potential benefits of the base isolation technique should not be taken for granted: they depend on many factors and are, sometimes, questionable (Shustov, 2000).

[0006] There are the following major reasons why the existing buildings, which are incorporating seismic isolators, performed below the expectations during the recent earthquakes:

[0007] 1. Predictions of their earthquake performance were made in assumption that the building structure have to act as a rigid body rocking on seismic isolators when the higher natural modes of vibration might be neglected.

[0008] 2. Possibility of a negative effect of heavy damping mechanism of those isolators, that could generate short pulses of high intensity, was overlooked.

[0009] 3. The buildings that were erected on seismic isolators remained essentially resonant systems in a wide range of earthquake frequencies.

[0010] However, if the existing buildings on seismic isolators happen to do their job properly and survive the earthquake impacts successfully, there is the opposite challenge: an earthquake safe, due to an effective seismic isolation, structure may become vulnerable to a strong wind. A sample of such seismic isolator may be found in a proposal to mount a building structure on rollers in order to reduce the earthquake impact which was made by Gonzalez-Flores in 1964 (Newmark and Rosenblueth, 1971). In 1993, the U.S. Patent No. 5,261,200 was issued to Sasaki et al. on a manufacture called "Vibration-Proofing Device" that was similar to the device proposed by Gonzalez-Flores. The device proposed by Gonzalez-Flores and by Sasaki et al. was modified at the California State University, Northridge and, under the name of "Earthquake Protective Building Buffer", it is now demonstrated online (Shustov, 2001).

BRIEF DESCRIPTION OF DRAWINGS

[0011] In the description of invention herein presented, references are made to the accompanying drawings, in which:

[0012] FIG. 1 is a perspective view of an earthquake protector.

[0013] FIG. 2 depicts an exploded perspective view of an earthquake protector divided into several functional strata.

DETAILED DESCRIPTION

[0014] The present invention will be described with reference to the accompanying drawings. As illustrated at FIG. 1 and FIG. 2, the earthquake protector according to the invention has three properly configured race pads, namely: a lower pad (1) resting on a building footing, an intermediate pad (2), and an upper pad (3) supporting the building superstructure (8). Top surface of the lower pad and bottom surface of the intermediate pad encompass a lower track (4). Top surface of the intermediate pad and bottom surface of the top pad encompass an upper track (5). Pads (1), (2) and (3) are able to slide mutually along their tracks. Two ring-shaped segmented slide tracks (4) and (5) contain plurality of freely revolving rollers (6) made of hard material. The cylindrical rollers (6) in each track are distanced from and stretched parallel to one another, while the tracks (4) and (5) are positioned above each other with their axes of rotational sliding being set horizontal and mutually orthogonal in order to provide an ad-

equate separating effect for any horizontal component of earth movement. The column stub (7) underpins and is framed into the building superstructure (8). The lower end (9) of the stub (7) is unrestrained against rotation and supported on the top surface of upper pad (3) with the help of a self-lubricating spherical foot bearing (10) in order to prevent an earthquake induced bending moments to propagate upwards into the building superstructure (8).

[0015] During an earthquake, any two-dimensional horizontal movement of the footing is resolved, while transmitted upwards, into two orthogonal components, by the following steps: first, the pad (2) will slide on pad (1) in one of the orthogonal directions relative to the footing; then, the pad (3) will slide on pad (2) in another orthogonal direction relative to the footing. Finally, a two-dimensional acceleration will be developed and applied to the bottom of the building superstructure (8). That acceleration will be dramatically scaled down in comparison with the acceleration of the footing due to a low value of the rolling friction in the tracks (4) and (5), as well as due to a rather big radius of the tracks curvature that ensures effectiveness of frequency separation.

[0016] Material, length, diameter, and a number of rollers in each

track, as well as sufficient curvature of the tracks and parameters of the stub's foot bearing, should satisfy both requirement of a proper vertical load bearing capacity and that of adequate shearing force being transmitted through the earthquake protector into the superstructure. Unlike its predecessors, the earthquake protector, through the mechanism of a properly chosen tracks curvature, can prevent the building superstructure separation from its foundation by controlling the building's ability to stay still on its footing under the strongest possible wind.